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BULLETINS AND PAPERS  
RELATING TO THE  
INCANDESCENT GAS LIGHTING INDUSTRY

INDOOR GAS ARC LAMP

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GENERAL ILLUMINATION BY WELSBACH ARCS



## INDOOR GAS ARC LAMP



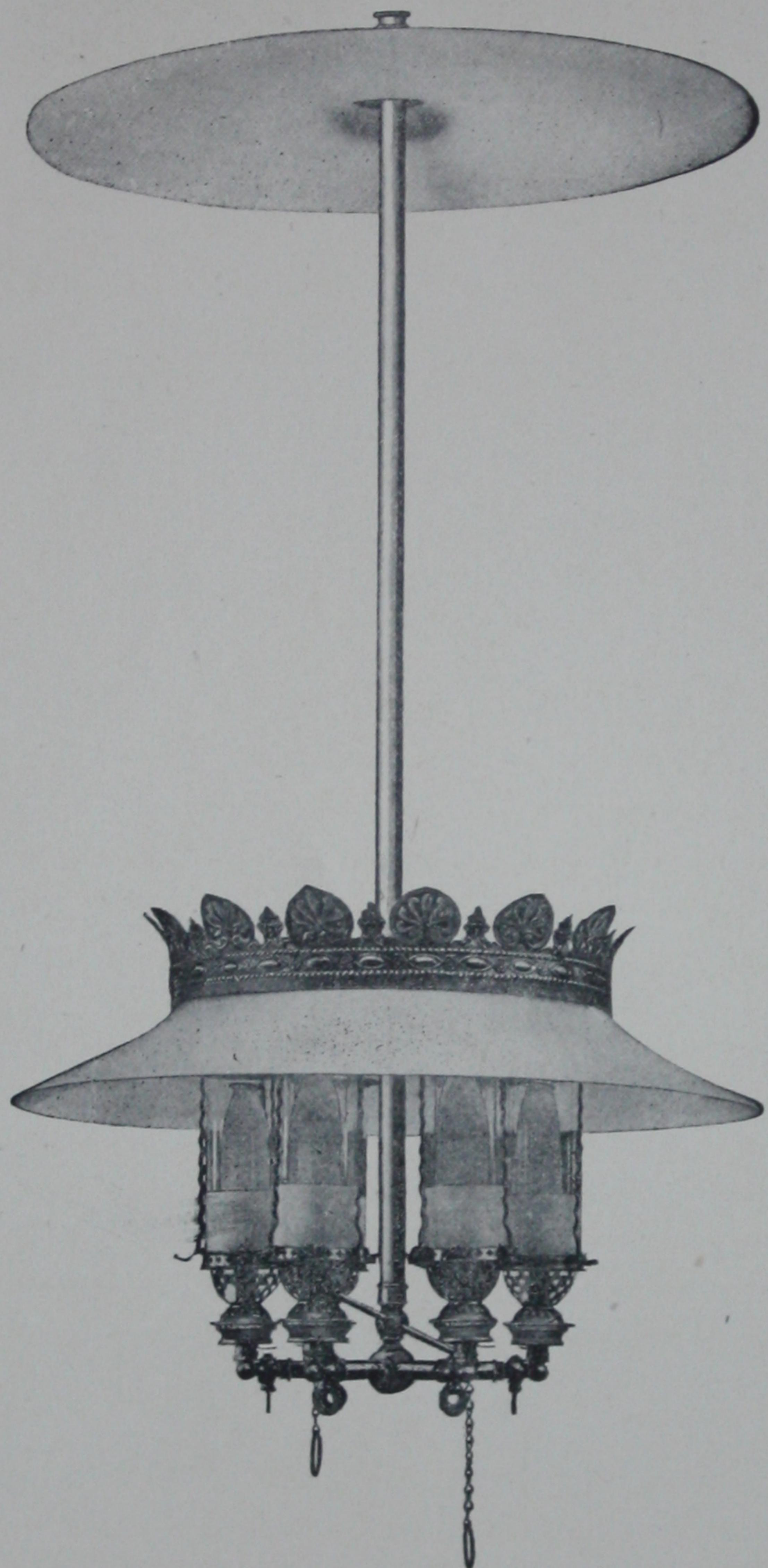
AS ARC LAMPS have been developed to fulfill a demand for a lighting unit of greater power than that supplied by the individual Welsbach burners, and the rapid strides in the growth of this form of lighting appliance have brought it to a position of prime importance in the field of practical illumination. The successful development of the modern Gas Arc Lamp to meet all the requirements imposed by Maintaining Companies and Users, and to fulfill the conditions imposed by Illuminating Engineers, has passed through various stages, and a brief review of the early forms and their basic features will be of interest.

### CLUSTER LAMPS.

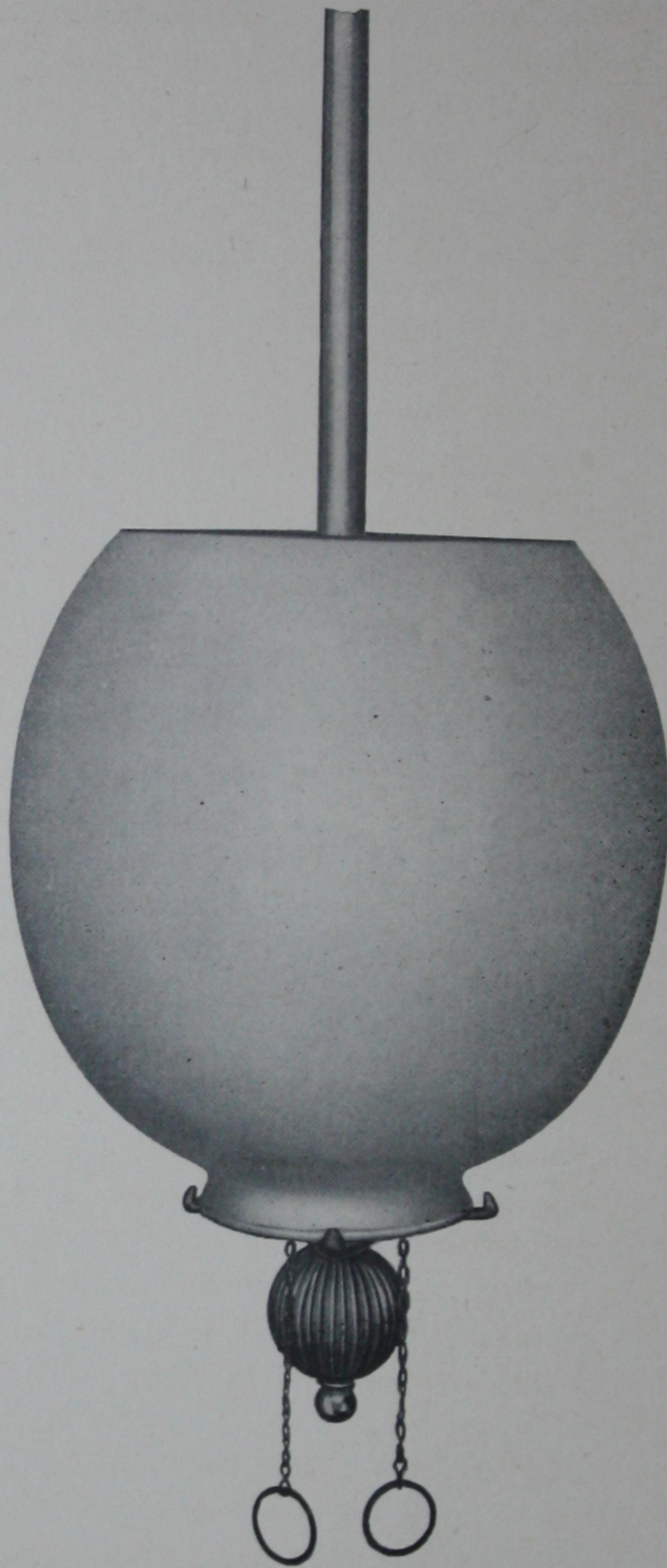
The first attempts at producing a high candle power unit were made in the form of a cluster of individual burners, with separate gas cocks and chimneys, gathered under a common reflector. These appliances were made in enormous quantities, principally in four- and six-light fixtures. While these clusters showed the normal efficiency of the individual Welsbach burner, their ultimate failure was largely due to the high cost of maintenance and the fact that the source of light was not concentrated. The separate burners with glass chimneys and complicated construction could not be made to meet the requirements of a simple and artistic lighting device.

The next step in the development was the introduction of a cluster of burners controlled by a single gas cock and surrounded by a round glass globe to replace the individual chimneys. This design of lamp was called a Gas Arc Lamp, and it met with fair success on account of its simplicity of construction and easy maintenance. Due consideration had not been given, however, to the question of efficiency in gas consumption, and as soon as it was realized that this lamp was grossly inefficient, experiments were undertaken to develop a more satisfactory appliance to meet these conditions.

Innumerable designs of arc lamps appeared about this time, but the greater number have since become obsolete. Some which have met with more or less success might be mentioned on account of novel principles introduced.



EARLY CLUSTER LAMP



EARLY GAS ARC LAMP

A lamp is being made with a single large Bunsen tube and mixing chamber surmounted by a cap containing a number of flame outlets to fit the standard sized mantles. The flames are regulated collectively by a single needle check in the Bunsen base, and the mantles are suspended on hooks attached to the center feed pipe.

Another lamp was introduced about this time with a single abnormally large Bunsen burner and mantle. It required a mantle several times the

standard size, and it was found that the cost of maintenance was enormously increased on account of the extreme delicacy and the high initial cost of these mantles. Furthermore, when the single mantle became damaged or broken the lamp was entirely out of commission.

### MODERN GAS ARC LAMPS.

On the basis of the experience received in the development and the failure of the earlier designs of cluster lamps, and on the constructive suggestions obtained from practical gas men and illuminating experts, it was appreciated by the Welsbach Company that a satisfactory Gas Arc Lamp must embody these basic features:

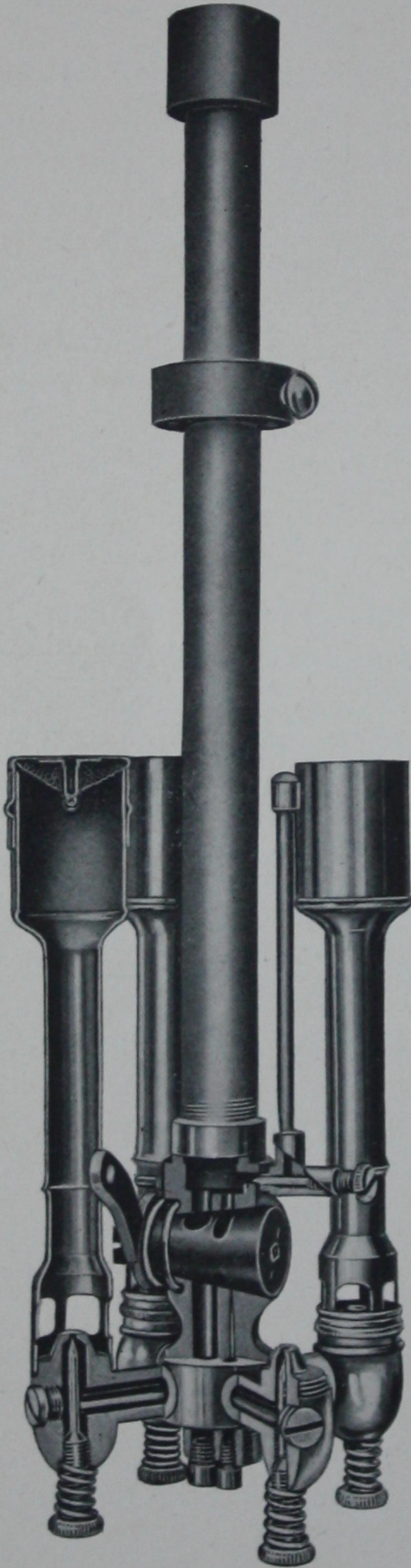
- First:** Concentration of the source of light.
- Second:** High efficiency.
- Third:** Minimum cost of maintenance.
- Fourth:** Individual adjustment for each burner.
- Fifth:** Night light.
- Sixth:** Sure and effective pilot lighting devices.

Under the heading of "Minimum Cost of Maintenance," it was appreciated that this must include simple operation for mantle renewal, elimination of all unnecessary glassware and parts, facilities for easily cleaning glassware, universal clean-out devices, single cock control, with the cock body so constructed as to permit of easy dissembling, cleaning and greasing. With a view to meeting these conditions our Company engaged the most competent mechanical engineers and lighting experts obtainable and undertook the solution of these problems step by step. After two years of experimental investigation and testing models, we put on the market an Indoor Gas Arc Lamp which meets all of the conditions and requirements suggested above, and it is the purpose of this article to describe in detail the construction and function of the vital features of our lamp.

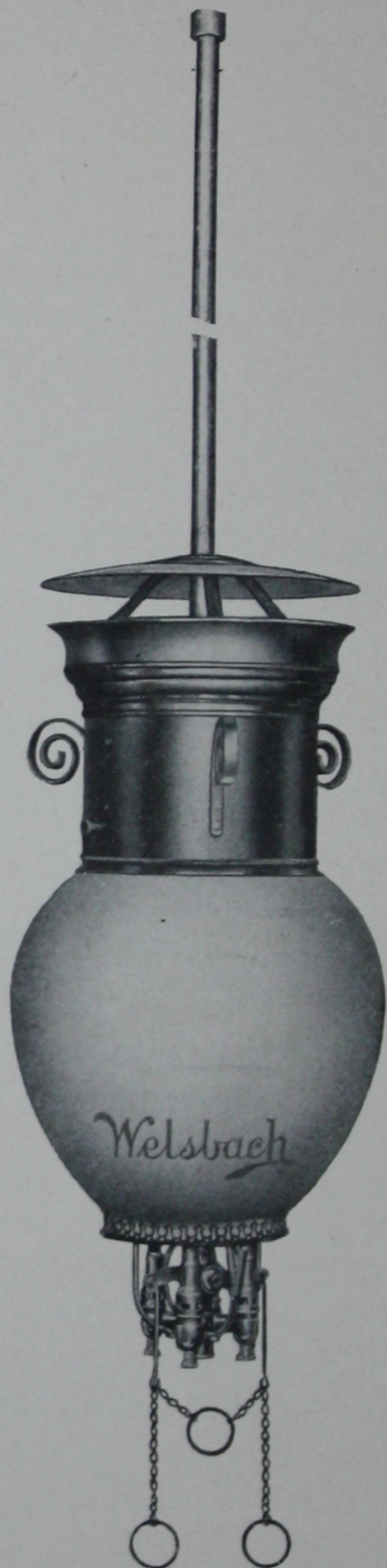
**COCK BODY.** The problem of producing a concentrated unit of light was met by constructing a cock body which would form the nucleus of the lamp, and from which arms would radiate at right angles for carrying the burners. These arms were made short in order to bring the burners as near as feasible to a common center, thus giving the effect of a concentrated source of light.

The cock body is designed to carry all of the attachments going to make up the cluster body of the lamp, such as Bunsen arms, pilot body, globe holder, center feed pipe, clean-out devices, gas ports for the night light, pilot and cluster. It is made from cold drawn brass rod milled and machined in jigs, thereby making it and all of its parts uniform and interchangeable.

**COCK PLUG.** The cock plug is made large in diameter in order to give the various gas ways the maximum amount of seal, and is given an extra degree of taper to obviate any possibility of sticking. As an additional safeguard the cock plug is held snugly in position by a compensating spring, the function of which is to take care of variations due to expansion



SECTIONAL CUT SHOWING STRUCTURAL  
DETAILS IN CLUSTER BODY



STANDARD FORM AND EQUIPMENT OF  
MODERN GAS ARC LAMP

and contraction under the influence of the heat of the lamp and, furthermore, compensate for any wear in service. While this spring keeps the plug seated it does not permit binding. In other designs of arc lamps the practice has been to ignore the necessity of compensating spring to take care of changes in temperature and wear by seating the cock plug loosely, which results after a short period of service in a noticeable gas leakage.

A unique feature in our construction of this part of the lamp is that the cock lever is mounted on the **small end** of the cock plug and is held in position by a square head slotted screw, which may be removed either with a screw driver, pliers or wrench. The mounting of the lever in this manner facilitates the work of the fitter when it is necessary to grease or clean the cock body or plug. The lever may be readily removed and the plug pushed out between the Bunsen arms on the opposite side of the lamp without disturbing in any way any other portion of the mechanism. In all competing designs of arc lamps this very important maintenance operation cannot be accomplished without more or less completely dissembling the lamp.

**BUNSEN BASES.** The Bunsen bases are made from cold drawn brass rod and formed on a riveting machine, after which they are drilled and tapped in jigs. Especial attention is directed to the fact that the Bunsen bases and check plates are made in one piece, thus insuring perfect registration between the needle point and the gas orifice, and the one-piece construction eliminates the common trouble with gas leakage at the check plate. Furthermore, the Bunsen base is made elliptical in shape so as to furnish longer bearing surface for the threads of the adjusting needle. These needles are **turned** from solid bar brass to insure perfect alignment.

**BUNSEN TUBES.** The Bunsen tubes are drawn from heavy brass and are made in two pieces, the upper detachable portion serving as the mixing chamber. The air ports are fitted with spring collars for air adjustment, which is necessary under certain gas conditions. The mixing chamber is supplied with a burner cap drawn from a heavy brass shell, pierced, in which a socket is provided for carrying a center support mantle. This pierced cap is made in one piece and is adjusted to the mixing chamber by a free sliding fit in order to facilitate cleaning or renewal.

**PILOT.** This lamp is provided with a very simple pilot lighting device, which is adjustable by an independent needle valve. The pilot gets its normal gas supply from the center feed pipe above the main cock. When the chain is pulled to light the lamp, an auxiliary gas supply is turned into the pilot, thereby producing the flash. The ports in the cock body are so arranged that two separate flashes are produced—one for lighting the night light and the other for lighting the remainder of the burners. This auxiliary gas supply

when turned into the pilot causes the flame to be projected up into the cluster of mantles and insures their lighting.

**NIGHT LIGHT.** The importance of the night light feature in cluster lighting arises from the fact that many consumers, desiring a small amount of light for all-night illumination, turn the light down by partly closing off the burner cock. This practice leads to rapid deterioration of mantles, possible carbonization and shrinkage, and in a good many cases to flash-backs, which result in destruction of the burner caps and clogging the Bunsen tubes. To meet this condition we have designed our burner cock in such a way that the lever has a **neutral** position, in which one burner is given its normal gas supply while the other burners are entirely cut off. The night light is turned on by the simple act of pulling down on the middle one of the three chain rings.

**ADJUSTMENT.** An important factor in the economical operation of an arc lamp is the proper gas adjustment. The working conditions in these lamps do not favor the use of the Mason multi-hole check, which is such a successful feature of the standard Welsbach burner. This lamp is provided with individual needle valve adjustments for each burner, as well as for the pilot, and great care should be taken to see that each burner is adjusted to give its maximum candle power, and that the pilot is adjusted to minimum gas consumption.

**CLEANING-OUT DEVICES.** The principal contributing factor in the rejection of the early designs of arc lamps was the failure on the part of designers and builders to consider the importance of cost of maintenance. No matter how perfect in design and construction, the features which contribute to economy in maintenance must be given a position of importance or the lamp will be ignored by companies engaged in the installation and care of these lights. Scientific construction and artistic design of fixtures pass for naught when it comes to gas ways clogged with dirt, and the importance of accessible clean-out devices cannot be overestimated.

Clean-out screws have been placed in such positions as to render every gas port in this lamp accessible, and any gas way or check in the lamp can be thoroughly cleaned by removing a screw and swabbing out without disturbing any other portion of the lamp. The clean-out devices of this lamp have been developed to such a point of simplicity and accessibility that there is no plausible excuse for a trimmer allowing the lamp to remain in a condition where it is not giving the highest initial efficiency. The gas adjusting screw for each Bunsen tube may be removed and wiped off. Clean-out screws are provided in the opposite ends of the horizontal arms of the Bunsen bases, which enable the trimmer to pass a wire or swab entirely through the cluster

body; while with the removal of the cap from the lower end of the cock body clean-out screws can be taken out, which will enable the trimmer to pass a swab vertically through the cluster body, the center feed pipe and the pipe beyond. The pilot tube and pilot body are easily removable for cleaning without disturbing any other portion of the lamp.

**DRAUGHT INDUCER.** The first great step in the improvement of the efficiency of the Gas Arc Lamp over the older types was the introduction of a draught inducer or stack. Scientific tests show that the introduction of this device increased the efficiency of these lamps from 25 to 40 per cent. A strong argument in favor of the importance of this feature is the fact that it has been almost universally copied by competitors.

Our stack is designed to fill the dual role of, first, Draught Inducer for the purpose of perfecting the combustion and increasing the efficiency; and second, as a Protector for the mantles during the various maintenance operations.

This draught inducer is of vital importance in districts where low gas pressures prevail, and is regarded by us as bearing the same relation to proper combustion in the arc lamp as a chimney does to proper combustion in the standard upright burner.

Especial attention is directed to the material and workmanship of our stack. It is made from a heavy drawn brass shell, quadruple nickel plated and polished. Close observation of various lamps in service have demonstrated that brass is the most durable metal for this purpose. The heavy nickel finish is not lacquered and is easily cleaned by the use of metal soap and a cleaning



SCIENTIFIC GLOBE CONSTRUCTION

rag. When a reflecting shade is used on the lamp it is suspended from the stack by means of clips, and a "heat baffle" may be rested over the stack on the supporting spider.

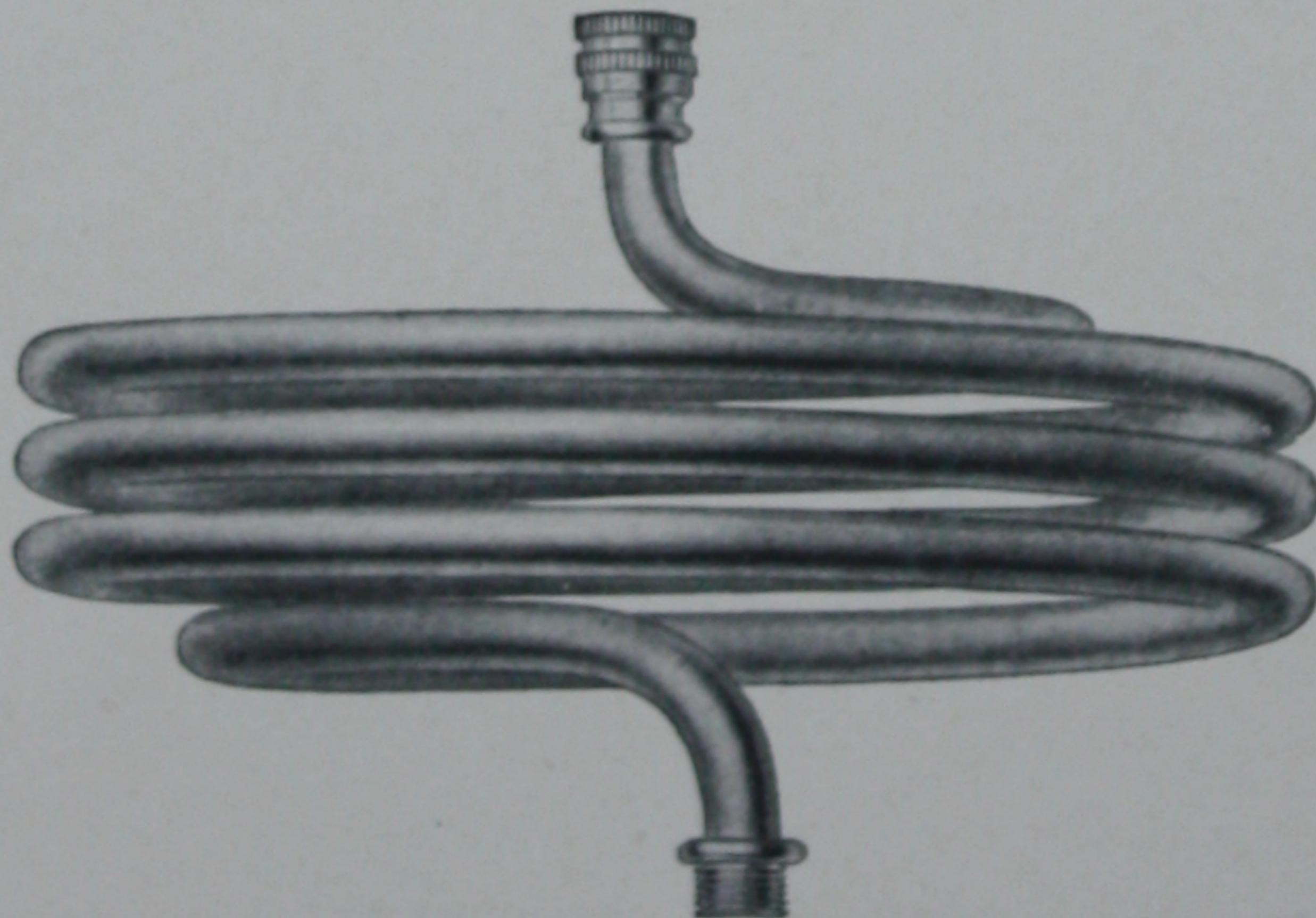
In competing lamps the stack is made of sheet iron, nickel plated. This does not permit of a satisfactory nickel plating and the iron rust stains begin to show after a very short period of service.

The efficiency of our lamp has been shown by many tests to be higher than that of any other lamp on the market—even those which have copied this improved feature. This is attributable to the fact that the combination of a stack of proper diameter with the **high globe** gives the full effect of a long chimney.

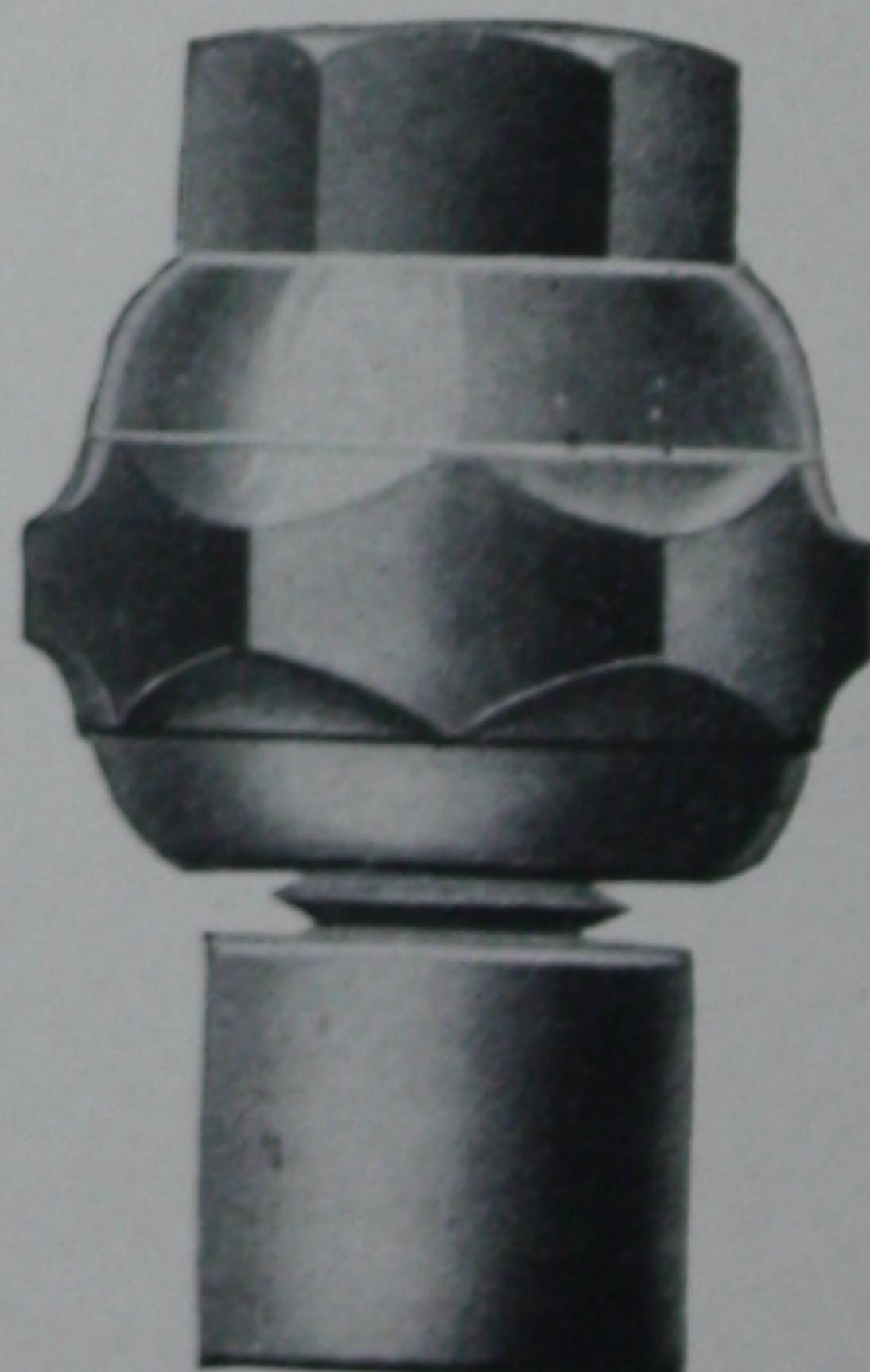
**GLASSWARE.** The next important improvement in the Gas Arc Lamp was made by the elimination of all glassware except the globe. Many original designs of Arc Lamps had a glass ceiling shield and a glass reflecting shade besides the globe, all of which had to be cleaned and renewed, adding materially to the cost of maintenance. The problem of meeting this glassware condition was taken up in the same manner as were the other vital points connected with the development of the Gas Arc Lamp, with the result that our engineers were able to design a single piece of glassware which fulfills the function of both globe and reflecting shade.

A scientifically designed pear-shaped globe made from alabaster glass was the result of this experimental investigation, and the most careful photometric tests prove that it fulfills the requirements of efficient illumination, and, in addition to this, it has the commendable feature of artistic appearance.

The upper portion of the globe is the same shape as a dome reflector, while its lower portion is so constructed as to give a very even distribution of light below the horizontal. (See cut.) The effect of this globe as a light diffuser can be shown by the simple experiment of spreading a piece of white paper



SIMPLE AND EFFECTIVE ANTI-VIBRATING FIXTURE

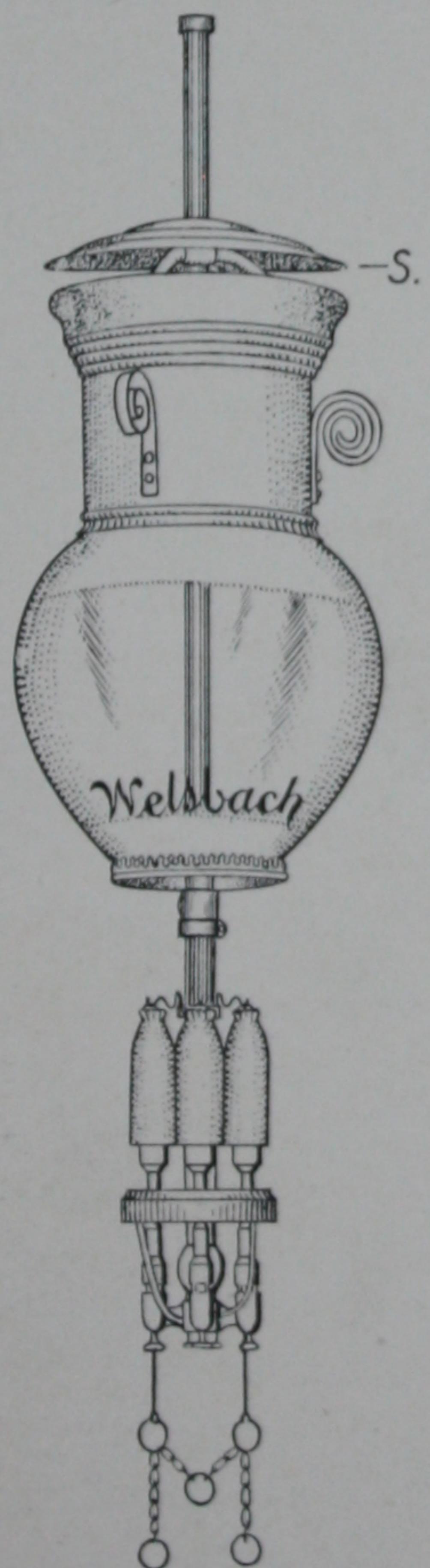


SWINGING BALL JOINT

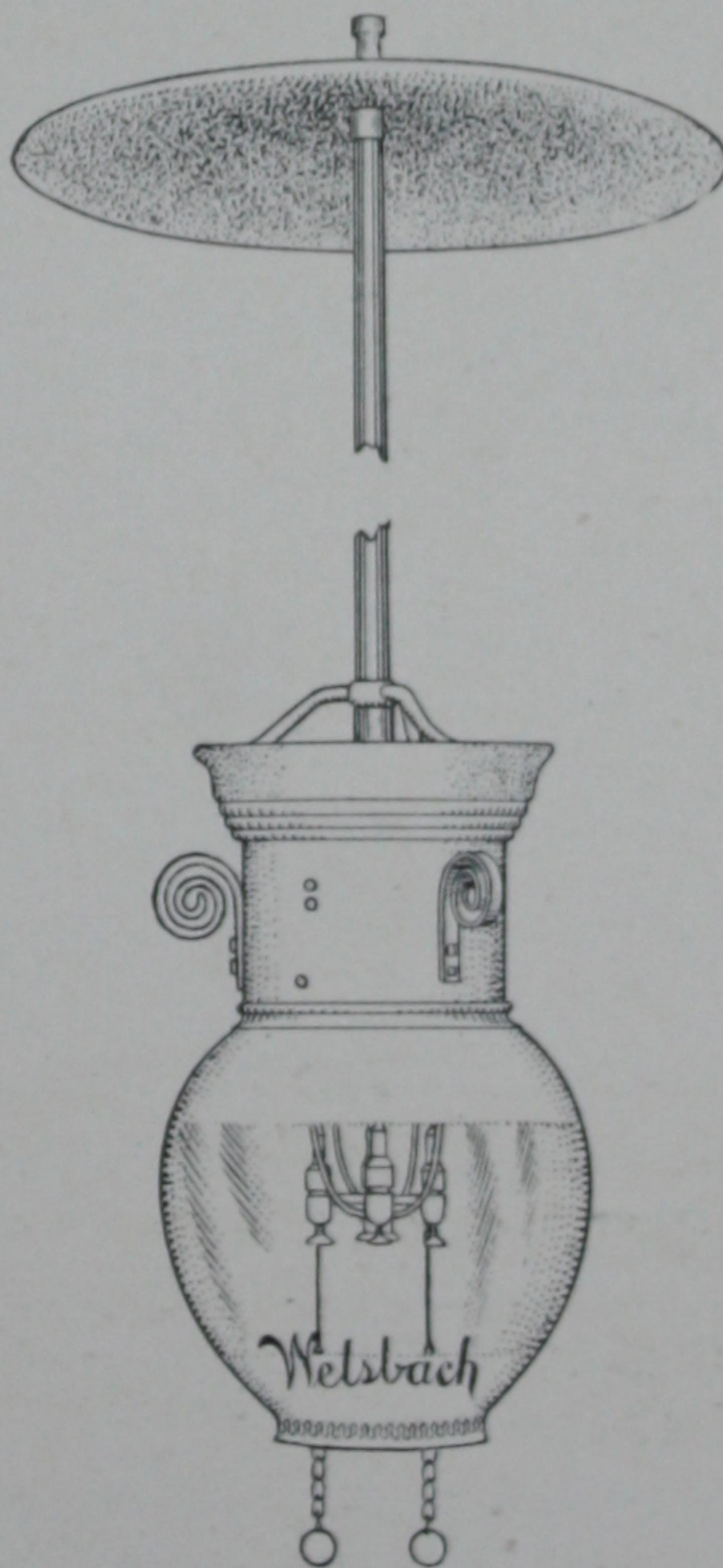
on the floor below the lamp and noting the absence of shadows, which one would naturally suppose would be present owing to the metal parts below the source of light.

While clear globes are made in pear-shaped design, it should be noted that they are not as effective as alabaster globes, and cannot from their nature fulfill the object for which alabaster globes are made. Furthermore, from the standpoint of general illumination the diffused light from the alabaster glass is vastly superior to the concentrated glare given by the clear globe. The alabaster globe presents a larger source of light of lower intensity, whereas the clear globe presents the concentrated effect of the exposed cluster of mantles.

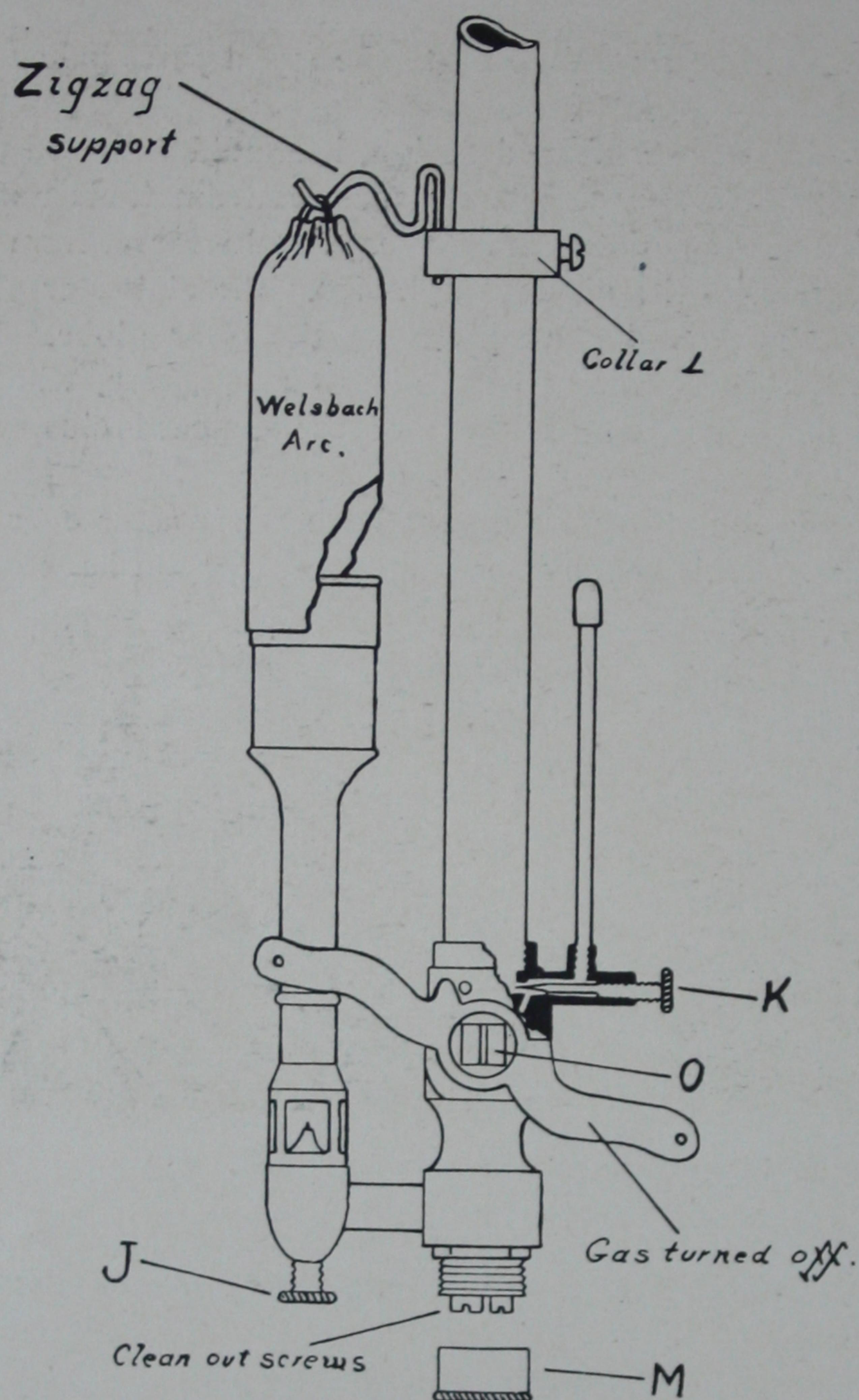
From a maintenance standpoint, alabaster globes have advantages over the clear globes, in that they do not so readily show spots, finger marks, etc., in cleaning.



GLOBE AND STACK RAISED  
AND LOCKED



GLOBE AND STACK LOWERED  
FOR CLEANING



METHOD OF MOUNTING MANTLE WITH ZIGZAG SUPPORT

**LABOR-SAVING DEVICES.** The Welsbach Gas Arc Lamp has incorporated in it some novel features which materially lessen the labor cost of maintenance. For example, mantles may be examined or renewed without removing the glassware from the lamp. This is accomplished by the simple operation of raising and locking the globe and draught inducer, as shown in Figure 1.

Another notable feature is that the globe may be lowered and cleaned without detaching from the lamp or without in any way endangering the safety of the mantles. This is accomplished by pressing in the spring triggers on the globe holder which support the globe collar and allowing the globe and



SHOWING METHOD OF  
PACKING ZIGZAG MANTLE  
SUPPORT

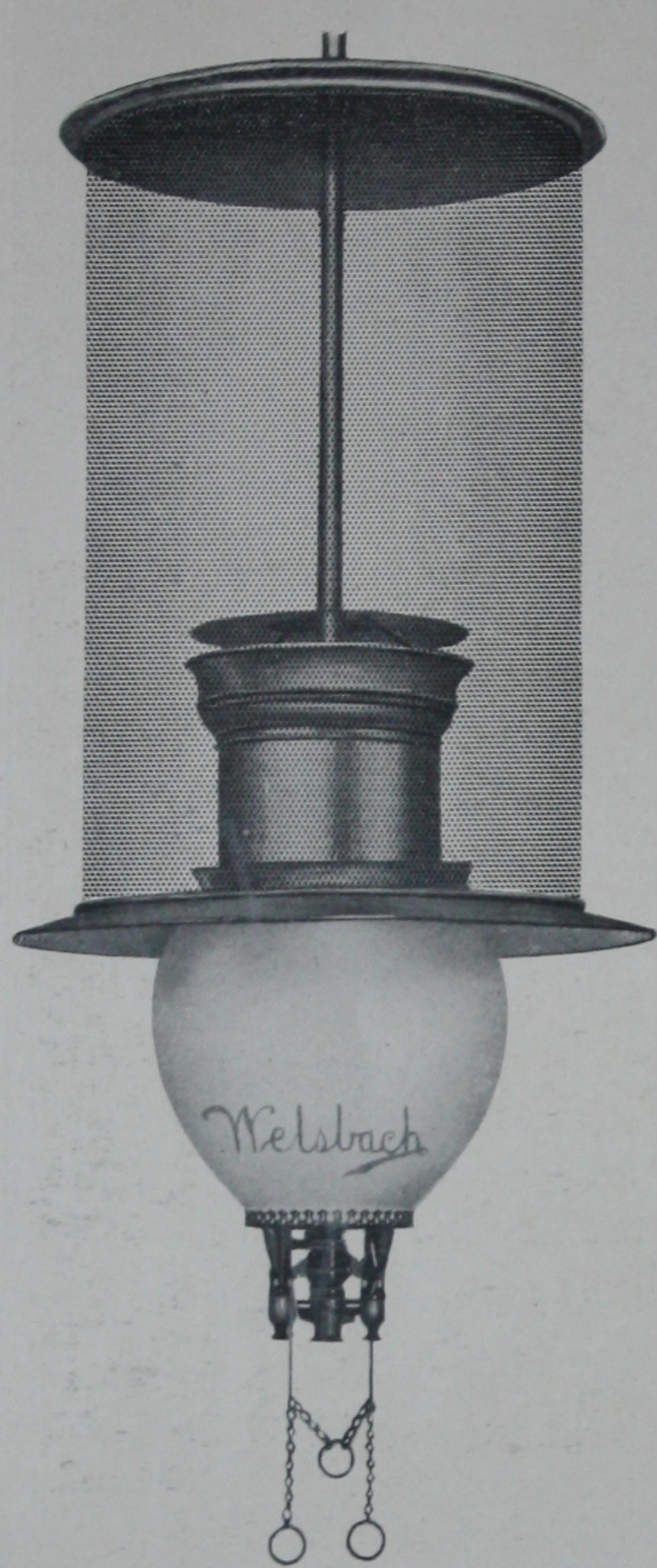


ASSEMBLING AND TESTING ARC LAMPS

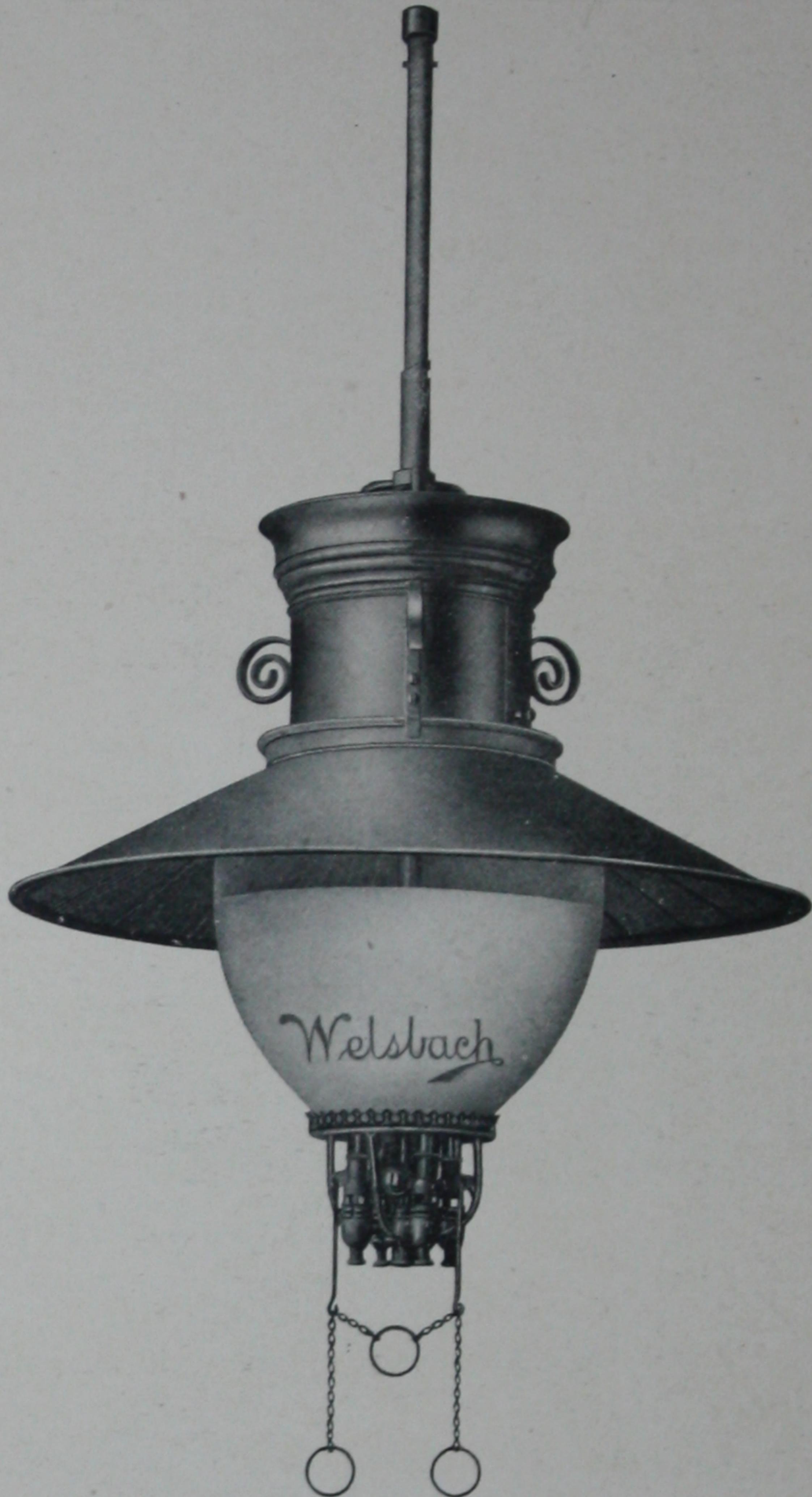
mantle protector to slide down. (Figure 2.) In this position the protector and globe may be revolved around the feed pipe, and the trimmer is enabled to wipe its entire inside surface without endangering the mantles. Should it become necessary, the globe can be detached from the lamp in this position by releasing a single set screw, leaving the **stack** as a protector for the mantles.

**ZIGZAG MANTLE SUPPORT.** This is a device for supporting the mantle from the center feed pipe of the lamp. (See cut.) It has many advantages over the magnesia center support, notably, it insures correct alignment of the mantles over the burners and tends to avoid carbonization, as there is no obstruction in the neck of the mantle. Furthermore, this method of suspending a mantle enhances its physical life and gives a more perfect and uniform incandescence.

In packing, the mantle is suspended in the box by the zigzag support. (See cut.) The handling of the mantle by the trimmer is eliminated, as it should be withdrawn from the box by taking hold of the zigzag support and directly attached to the supporting collar of the lamp, a very simple and safe operation.



FACTORY ARC LAMP WITH SCREEN  
FOR COTTON MILL LIGHTING



LAMP EQUIPPED WITH SILVER GLASS  
REFLECTOR FOR WINDOW LIGHTING

The Welsbach Arc mantle will be supplied packed with zigzag support without additional charge when so ordered.

#### THE APPLICATION OF THE GAS ARC LAMP.

The Gas Arc Lamp, on account of its powerful light, is admirably adapted to all forms of commercial and other large interior lighting. In candle power it actually exceeds the modern enclosed electric arc, and the soft, mellow, steady light of great diffusion is far preferable to the bluish-white or violet wavering light of the electric lamp. Furthermore, the cost of illumination by

the Gas Arc Light is only about one-fourth that of the electric lamp for equal candle power.

**INDUSTRIAL LIGHTING.** In workshops the Gas Arc Lamp can be used to great advantage for the general illumination of the room. A special modification of the No. 905 model is made for factory use, finished in black bronze and furnished without the scroll ornaments. This lamp is usually equipped with the alabaster globe, sometimes enameled steel reflector. It is usually hung on the No. 5 anti-vibration fixture, which takes



WINDOW LIGHTING WELSBACH ARCS

up the vertical and lateral vibrations without throttling the gas flow. The great simplicity of this equipment renders it particularly effective and economical for factory lighting.

A modification of this lamp is made for use in cotton mills, and several thousand of them have been installed in these factories in the neighborhood

of Philadelphia. The standard factory lamp is used with enameled steel reflector, on top of which is placed a gauze protector to prevent lint or other inflammable particles falling into the top of the stack. These lamps are also equipped with the heat baffle and dust catcher.

**STORE WINDOW LIGHTING.** In lighting store windows it is necessary to direct the light downward. The standard No. 905 equipment is used for this purpose, but with a specially designed cone reflector, made of sheet metal, lined with facets of corrugated mirror glass. This is used in combination with the pear-shaped globe, the lower portion of which is frosted and the upper portion clear. The frosting cuts off the direct glare of the mantles, while the clear portion allows all the rays to strike the reflector, which is so designed as to throw the light down to the floor of the window.

While it is obviously outside of the scope of this paper to give more than a suggestion as to the enormous field for the application of the Gas Arc Lamp, representative installations can be shown in every commercial and industrial field requiring artificial illumination.



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